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Flowing Afterglow Deposition for Indium Phosphide Interfacial Studies

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Introduction

Flowing Afterglow Chemical Vapor Deposition (FACVD) is a new materials growth process which has been under development at Wayne State University. The project is still in its early phases, but is promising because of its potential for producing novel kinds of materials suitable for microelectronic and optical applications.

Metallo-organic chemical vapor deposition (MOCVD) is a natural evolutionary step forward from CVD material growth systems. Whereas normal CVD requires temperature control over several heated zones, MOCVD requires control over only one heated zone. The equilibration time is therefore considerably shorter and much sharper compositional changes (greater control) can be achieved. The FACVD process is the next evolutionary step forward from MOCVD. The method permits a complicated mix of physical deposition, chemical vapor deposition (CVD), and plasma deposition techniques to be used simultaneously in a single system. FACVD should not be regarded as simply a hybrid approach. It contains a number of unique features that have never before been applied to material growth problems. There is reason to believe that the unique features of the FACVD process will permit operation in regimes previously inaccessible to MOCVD.

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Progress on Indium Phosphide

The Engineering Building at Wayne State has been vacated and is undergoing a massive renovation. As a consequence, the laboratory housing the FACVD has been inaccessible since April of 1984. During this period, the equipment was relocated in the Physics building, but a fourteen month disruption occurred before the main pumping system became operational. Despite these problems, the system was reconstructed piece by piece in the fall of 1985 and is now basically functional.

System operation has been considerably enhanced over the previous preliminary setup. The present FACVD system is capable of stable operation in pressure regimes ranging from 0.2 torr to over 50 torr. Throughout most of this range, it is possible to vary the length of the plasma jet from a few centimeters to well over one meter. In the substrate deposition region, the associated variation in ion and metastable state density exceeds three orders of magnitude. Work has continued on the fabrication of various components integral to the system. Special high temperature heaters and cathode assemblies have been designed and tested. Theoretical and design studies are continuing to improve the performance of the system.

The recent work on InP at Bendix suggests that phosphorus rich graded junctions are capable of solving the interfacial problems that have blocked previous progress on InP MISFET devices. In our system, the variation in plasma, substrate, and deposition combinations is so enormous that in situ monitoring is required to find the optimum mix of deposition parameters. For this reason a real-time digitized image processing system is now being assembled to monitor the deposition region.

Because of the relocation problems, no items from the DOD equipment grant have been ordered. A one year extension of the grant period is urgently requested.